

→ 3rd ADVANCED COURSE ON RADAR POLARIMETRY POISARpro v5.0



TOOLBOX

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19–23 January 2015 | ESA-ESRIN | Frascati (Rome), Italy

European Space Agency

A Bit Of History



PolSARpro

A BIT OF HISTORY





The initiative development of **PolSARpro Software** is a direct result of recommendations made during the **POLinSAR 2003 Workshop** held at ESA-ESRIN in January 2003.



A BIT OF HISTORY

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Exit

(est) (3.0



2009 (v4.0) - 2011 (v4.2)

European Space Agency

www.esalist

Tool specifically designed to handle : Polarimetric data and Polarimetric Interferometric data.



esa

Educational Software offering a tool for self-education in the field of POLSAR and POL-InSAR data processing and analysis.





Developed to be accessible to : a wide range of users from novices to experts in the field of POLSAR and POL-InSAR.



www.esa.int

European Space Agency





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鴙띰.

MODULAR STRUCTURE

Each element of the Software (a function) can be extracted and incorporated individually into users' own processing software.







鴙밈

MODULAR STRUCTURE

Users can easily add their own functions and components, as PolSARpro v5.0 Software is conceived as a flexible and open software environment.





OPEN SOURCE DEVELOPMENT

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PolSARpro v5.0 Software is made available following the:

Open Source Software Development (OSSD)

approach, and follows the:

GNU General Public License v2 – June 1991.

PolSARpro v5.0 Software runs today on:

Windows 98+, Windows 2000, Windows NT 4.0, Windows XP, Windows 7 and Linux I386

Macintosh OS:



http://earth.esa.int/web/polsarpro/home

New! V5.0.4 (14/01/2015)



The Web Site provides

- Details of the project
- Access to the tutorial and software
- Information about status of the development
- Demonstration Sample Datasets

PolSARpro v5.0 Team & Contributorsesa











Pol-SAR Sensors

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PolSARpro v5.0 Software offers the possibility to handle and convert polarimetric data from a range of well established polarimetric airborne platforms.

esa



PolSARpro v5.0 Software offers the possibility to handle and convert polarimetric data from a range of well established polarimetric space.

🖊 ALOS Input Data File (JAXA - CEOS Format)
F:/PolSARpro_Data/PolSAR_Data/ALUS/Montpellier
Output Directory
F:/PolSARpro_Data/PolSAR_Data/ALOS/Montpellier
SAR Leader File (LED-xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
F:/PolSARpro_Data/PolSAR_Data/ALOS/Montpellier/LED-ALPSRP045780870-P1.1A
Scene ID ALPSRP045780870 Mode Quad Pol Mode Check Files Image: Check Files
F:/PolSARpro_Data/PolSAR_Data/ALOS/Montpellier/TRL-ALPSRP045780870-P1.1A
SAR Image Files
s11 F:/PolSARpro_Data/PolSAR_Data/ALOS/Montpellier/IMG-HH-ALPSRP045780870-P1.1A
s12 F:/PolSARpro_Data/PolSAR_Data/ALOS/Montpellier/IMG-HV-ALPSRP045780870-P1.1_A
s21 F:/PolSARpro_Data/PolSAR_Data/ALOS/Montpellier/IMG-VH-ALPSRP045780870-P1.1_A
s22 F:/PolSARpro_Data/PolSAR_Data/ALOS/Montpellier/IMG-W-ALPSRP045780870-P1.1_A
Read Header Edit Header Edit Header
COMPLEX SAR IMAGE
Initial Number of Rows 18432 Initial Number of Cols 1248
OK Z Cancel

ALOS – PALSAR



ALOS-PALSAR Polar Modes

• PALSAR Dual & Quad POL

• PALSAR Data Level 1.1 and 1.5

JAXA - CEOS Data Format

🖊 ALOS Input Data File (ERSDAC - Yexcel Format)	
- Input Directory-	
C:/ALOS_Rennes/quad	_
Output Directory	
C:/ALOS_Rennes/quad	
SAR Meta File	
C:/ALOS_Rennes/quad/PASL1100706032214150806100000.meta	
Check Files Edit Header Solarisation Mode	full
SAR Image Files	
s11 C:/ALOS_Rennes/quad/PASL1100706032214150806100000.hh.SLC	
s12 C:/ALOS_Rennes/quad/PASL1100706032214150806100000.hv.SLC	
s21 C:/ALOS_Rennes/quad/PASL1100706032214150806100000.vh.SLC	
s22 C:/ALOS_Rennes/quad/PASL1100706032214150806100000.vv.SLC	
Initial Number of Rows 19296 Initial Number of Cols 1328	
Convert Input IEEE binary Format (LE<->BE)	
OK 😰 Cancel	

ALOS – PALSAR



ALOS-PALSAR Polar Modes

• PALSAR Dual & Quad POL

• PALSAR Data Level 1.1

ERSDAC - Vexcel Data Format

🦸 RADARS	6AT2 Input Da	ta File						×
-Input Direc	story ———		b					
C:/RS2_OK	3657_PK50015	DK49529_F	Q19_20090	112_054213	3_HH_VV_HV	_VH_SLC		
- Output Dire	ectory							
C:/RS2_OK	3657_PK50015j	DK49529_F	Q19_20090	112_054213	3_HH_VV_HV	_VH_SLC	6	≥∥
- SAR Produ	uct File							
C:/RS2_OK	3657_PK50015_	DK49529_F	Q19_20090	112_054213	3_HH_VV_HV	_VH_SLC/	product 2	ž
- Output Sca	aling Look-Up-Ta	able (LUT) -						
0	Beta-Nought		O Gamma	-Nought	G	Sigma-No	ought	
Read H	teader	Edit Heade	er		Polarisatio	n Mode	full	
	2657 PK50015	DK49529 E	019 20090	112 05/213			mageru 0	2
	File (s12)	DIC40020_1	Q15_20030	1112_004210		_vn_ocon		
C:/BS2_OK	3657 PK50015	DK49529 F	Q19 20090	112 054213	з нн уу ну	VH SLC/	magery D	2
- Input Data	File (s21)							
C:/RS2_OK	3657_PK50015	DK49529_F	Q19_20090	112_054213	3_HH_VV_HV	_VH_SLC/i	magery D	3
r_Input Data	File (s22)			_			_	
C:/RS2_OK	3657_PK50015	_DK49529_F	Q19_20090	112_054213	3_HH_VV_HV	_VH_SLC/i	magery 2	2
	Initial Numbe	r of Rows	6918	Initial Nun	nber of Cols	3644]	
	ок		2			Cancel		



Dual & Quad POL Fine and Standard Mode

🦸 TerraS/	AR-X Input Dat	a File			
		2	The second		
Input Direc	ctory				
E:/PolSARp	oro_Data/PolSAR	_Data/TerraSAR-X.	/TerraSAR_Data	a/belzig	
Output Din	ectory-				
E:/PolSARp	oro_Data/PolSAR	_Data/TerraSAR-X	/TerraSAR_Data	a/belzig	
SAR Prod	uct File				
E:/PolSARp	oro_Data/PolSAR	_Data/TerraSAR-X	/TerraSAR_Data	/belzig/TSX1_SAR_	_SSC 🖻
_	Read Header		Edit Header		
Product	Single Look Sl	ant Range - Comple	x	Imaging Mode	StripMap
Resolution	n/a			Polarization Mode	Dual Pol
- Input Data	File (s11)				
E:/PolSARp	oro_Data/PolSAR	_Data/TerraSAR-X	/TerraSAR_Data	/belzig/IMAGEDATA	/IMAGE_H 🗃
- Input Data	File (s22)				
E:/PolSARp	pro_Data/PolSAR	_Data/TerraSAR-X.	/TerraSAR_Data	/belzig/IMAGEDATA	/IMAGE_V 💕
P					
					`
	Initial Number	of Rows 2304	7 Initial Num	ber of Cols 7920	
	ок		2	Cano	cel

• TerraSAR – X Dual POL

TerraSAR – X



SSC: Single Look Slant Range Complex **EEC:** Enhanced Ellipsoid Corrected

GEC: Geocoded Ellipsoid Corrected **MCD:** Multi-Look Ground Range

🦸 TerraSAI	R-X Input Da	ta File				
Input Direct	ory					
E:/PolSARpr	o_Data/PolSAI	R_Data/Terra	SAR-X/T	erraSAR_Data	a/belzig	
Output Dire	ctory					
E:/PolSARpr	o_Data/PolSAl	R_Data/Terra	SAR-X/T	erraSAR_Data	a/belzig	
SAR Produc	ot File					
E:/PolSARpr	o_Data/PolSA	R_Data/Terra	SAR-X/T	erraSAR_Data	/belzig/TSX1_SAR_	_SSC 😅
F	Read Header			Edit Header		
Product	Single Look S	ilant Range - C	Complex		Imaging Mode	StripMap
Resolution	n/a				Polarization Mode	Dual Pol
- Input Data F	File (s11)					
E:/PolSARpr	o_Data/PolSA	R_Data/Terra	SAR-X/T	erraSAR_Data	/belzig/IMAGEDATA	VIMAGE_H 🗃
- Input Data F	File (s22)					
E:/PolSARpr	o_Data/PolSA	R_Data/Terra	SAR-X/T	erraSAR_Data	/belzig/IMAGEDATA	VIMAGE_V 🔗
						**
[Initial Numbe	er of Rows	23047	Initial Num	ber of Cols 7920)
	ок		2		Can	cel

• TerraSAR – X Quad POL

TerraSAR – X



SSC: Single Look Slant Range Complex



PolSARpro v5.0 Software offers the possibility to handle and convert polarimetric data from a range of well established polarimetric spaceborne platforms.

🧣 TANDEM-X Input Data File
- Input Directory-
D:/PoISAR_Data/Juanma/Rice_Scene
- TANDEM-X Product File
D:/PoISAR_Data/Juanma/Rice_Scene/TDM1_SARCOS_BIST_SM_D_SRA_20110608T062951_201106
Read Header Edit Header Polarization Mode Dual Pol : pp3
- Input Master Directory
D:/PoISAR_Data/Juanma/Rice_Scene/TSX1_SARSSC_BTX1_SM_D_SRA_20110608T062951_201106(
- Output Master Directory
D:/PoISAR_Data/Juanma/Rice_Scene/master
- Input Slave Directory
D:/PoISAR_Data/Juanma/Rice_Scene/TDX1_SARSSC_BRX2_SM_D_SRA_20110608T062951_201106
-Output Slave Directory-
D:/PoISAR_Data/Juanma/Rice_Scene/slave
Master Directory Slave Directory Slave Directory
Edit Header Initial Number of Cols 12894
Input Master Data File (s11)
D:/PoISAR_Data/Juanma/Rice_Scene/TSX1_SARSSC_BTX1_SM_D_SRA_20110608T062951_2011060
- Input Master Data File (s22)
D:/PoISAR_Data/Juanma/Rice_Scene/TSX1_SARSSC_BTX1_SM_D_SRA_20110608T062951_2011060
Input Slave Data File (s11)
D:/PoISAR_Data/Juanma/Rice_Scene/TDX1_SARSSC_BRX2_SM_D_SRA_20110608T062951_2011061
- Input Slave Data File (s22)
D:/PoISAR_Data/Juanma/Rice_Scene/TDX1_SARSSC_BRX2_SM_D_SRA_20110608T062951_2011061
OK 🛛 🕅 🕅 Cancel

TANDEM – X



SSC: Single Look Slant Range Complex

• TanDEM – X Dual POL

I TANDEM-X Input Data File		
- Input Directory-		1 The file - Train
D:/PoISAR_Data/Juanma/Rice_Scene		
- TANDEM-X Product File	American State and State and	
D:/PoISAR_Data/Juanma/Rice_Scene/TDM1_SARCOS_BIST_SM_D_SRA_20110608T062951_201106		
Read Header Edit Header Polarization Mode Dual Pol: pp3 Signature Input Master Directory		
D:/PolSAR_Data/Juanma/Rice_Scene/TSX1_SARSSC_BTX1_SM_D_SRA_20110608T062951_2011060		
- Output Master Directory		
D:/PoISAR_Data/Juanma/Rice_Scene/master		
- Input Slave Directory		
D:/PoISAR_Data/Juanma/Rice_Scene/TDX1_SARSSC_BRX2_SM_D_SRA_20110608T062951_201106		
- Output Slave Directory		
D:/PoISAR_Data/Juanma/Rice_Scene/slave		
Master Directory Initial Number of Rows 8836 Edit Header Initial Number of Cols 12894		
- Input Master Data File (s11)		
D:/PoISAR_Data/Juanma/Rice_Scene/TSX1_SARSSC_BTX1_SM_D_SRA_20110608T062951_2011060		
- Input Master Data File (s22)		
D:/PoISAR_Data/Juanma/Rice_Scene/TSX1_SARSSC_BTX1_SM_D_SRA_20110608T062951_2011060		
Input Slave Data File (s11)		
D:/PoISAR_Data/Juanma/Rice_Scene/TDX1_SARSSC_BRX2_SM_D_SRA_20110608T062951_201106		
- Input Slave Data File (s22)		
D:/PoISAR_Data/Juanma/Rice_Scene/TDX1_SARSSC_BRX2_SM_D_SRA_20110608T062951_2011061 🔗		
OK 🖸 🕅 Cancel		

• TanDEM – X Dual POL

🖉 COSMO-SKYMED Input Data File	×
Input Directory	
D:/D_POLSAR_DATA/CSK_Images/10F02911-114_20120211_sougeal/7zEF9CC.tmp	
Output Directory	5
D:/D_POLSAR_DATA/CSK_Images/10F02911-114_20120211_sougeal/7zEF9CC.tmp	7
SAR Product File	
D:/D_POLSAR_DATA/CSK_Images/10F02911-114_20120211_sougeal/7zEF9CC.tmp/CSKS1_5	;
Check Files	
Satellite ID CSKS1 Station ID 1300/EACQ01/Cordoba Frequency 9.6e+009	
Incidence Angle 40 Look Side RIGHT Orbit Direction ASCENDING	
Column Spacing 5.32964 Line Spacing 2.23547 Polar Type pp1	
Scene Sensing Start 2012-02-11 05:51:50.924511579 Stop 2012-02-11 05:51:57.563389080	
Dump hd5 to bin Files Dumping Dataset S02-SBI to HH binary file	
Initial Number of Rows 19016 Initial Number of Cols 4123	
OK 2 Cancel	

COSMO-SKYMED



SSC: Single Look Slant Range Complex

COSMO-SKYMED Dual POL





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COSMO-SKYMED Dual POL

RISAT

🖉 RISAT Input Data File (CEOS Format)	×
- Input Directory	
D:/D_POLSAR_DATA/FRS-1/9441sd1_s33_SLC	_
Output Directory	
D:/D_POLSAR_DATA/FRS-1/9441sd1_s33_SLC	- 0
Band-Meta File	
D:/D_POLSAR_DATA/FRS-1/9441sd1_s33_SLC/BAND_META.txt	_
Read Header Scene ID ENTER SCENE ID ?? Mode Compact - Pol Mode FRS1 Level SLC Format CEOS Inc Ang 4 Image: Same Res Rg 3.332 Res Az 2.340 Pix Rg 1.801 Pix Az 2	4.068
D:/D_POLSAR_DATA/FRS-1/9441sd1_s33_SLC/scene_RV/lea_01.001	
SAR Image Files	
s11 D:/D_POLSAR_DATA/FRS-1/9441sd1_s33_SLC/scene_RH/dat_01.001	
s12 D:/D_POLSAR_DATA/FRS-1/9441sd1_s33_SLC/scene_RV/dat_01.001 s21	
Initial Number of Rows 13632 Initial Number of Cols 10748	
OK Cancel	



• **RISAT Dual POL – Compact POL**

🧣 ALOS Input Data File (JAXA - CEOS Format)	
- Input Directory	
D:/ALOS2	
- Output Directory	
D:/ALOS2	0
SAB Info XML File (INF-xxxxxxxxxxxxxxxxxxxxxx)	
D:/AL0S2/INF-AL0S2015387000-140905-HBQR1.1A.xml	ī 🗃
Check Files Inc Angle 30.400000 Mode quad1.1	
SAR Lorder File	
D:/AL 0.52/LED:AL 0.52015387000-140905-HB0B1.1 A	
SAR Trailer File	
D:/AL0S2/TRL-AL0S2015387000-140905-HBQR1.1A	
- SAR Volume File	
D:/ALOS2/VOL-ALOS2015387000-140905-HBQR1.1A	
12 D. /AL 0C2/MC //L AL 0C2015007000140005 UD0D1 1	
s12 D./ALOS2/IMG-VH-ALOS2015367000-140305-BQR1.1A	—
221 D./ALOSZ/ING/HV-ALOS2015367000-140305-HD0.D1 1	—
\$22 D.7ALUS2/IMG-VV-ALUS2015387000-140305-HBQR1.1_A	
Read Header Edit Header COMPLEX SAR IMAGE	
Initial Number of Rows 22609 Initial Number of Cols 8112	-
Row pixel spacing 3.215856 Col pixel spacing 2.860844	
ОК Сапсе	

ALOS – PALSAR



ALOS-PALSAR Polar Modes
PALSAR Dual & Quad POL

• PALSAR Data Leve 1.1 and 1.5

New!

JAXA - CEOS Data Format

🦨 ALOS Input Data File (JAXA - CEOS Format)
Input Directory
D:/AL0S2
Output Directory
D:/ALOS2
SAR Info XML File (INF-xxxxxxxxxxxxxxxxxxxxxx)
D:/ALOS2/INF-ALOS2015387000-140905-HBQR1.1A.xml
Check Files Inc Angle 30.400000 Mode quad1.1 Node Ascending Data Level 1.1
- SAR Leader File
D:/AL0S2/LED-AL0S2015387000-140905-HBQR1.1A
SAR Trailer File
D:/ALOS2/TRL-ALOS2015387000-140905-HBQR1.1A
- SAR Volume File
D:/ALUS2/V0L-ALUS201538/000-140905-HBQR1.1A
s11 D:/ALOS2/IMG-HH-ALOS2015387000-140905-HB0R1.1 A
s12 D:/ALOS2/IMG-VH-ALOS2015387000-140905-HB0B1.1 A
s21 D:/ALOS2/IMG-HV-ALOS2015387000-140905-HB0R1.1 A
s22 D:/ALOS2/IMG-VV-ALOS2015387000-140905-HB0R1.1 A
Read Header Edit Header COMPLEX SAR IMAGE
Initial Number of Rows 22609 Initial Number of Cols 8112
Row pixel spacing 3.215856 Col pixel spacing 2.860844
OK 📿 Cancel



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JAXA - CEOS Data Format

🦨 SENTINEL1 Input Data File
- Input Directory
D:/S1A_IW_SLC1SDV_20140826T170517_20140826T170544_002114_0021B6_D3F2.SAFE
- Output Directory
D:/S1A_IW_SLC1SDV_20140826T170517_20140826T170544_002114_0021B6_D3F2.SAFE
Mission S1A Acquisition IW Product SLC Level 1 Polarisation pp2
Swath Burst / Slice Sice
Azimut Pixel Spacing 13.92 Range Pixel Spacing 2.32 Incidence Angle 39.08
- Input Data File (Co - Pol)
D:/S1A_IW_SLC1SDV_20140826T170517_20140826T170544_002114_0021B6_D3F2.SAFE
— Input Data File (X - Pol)
D:/S1A_IW_SLC1SDV_20140826T170517_20140826T170544_002114_0021B6_D3F2.SAFE
Initial Number of Rows 15138 Final Number of Rows 1459
Initial Number of Cols 24888 Final Number of Cols 24440
OK 🛛 Cancel



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- Dual Pol datasets
- SLC product (level 1)
- IW & EW mode





Selection of the burst to be processed (can also process ALL the bursts of a swath)



SLC - IW : Swath 2 – Burst 4







Slant range (no geocoding)

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Software – General Presentation



PolSARpro v5.0 SOFTWARE Cesa - U × Polarimetric SAR Data Processing and Educational Tool v5.0 - Menu ASE C esa SNAP About 💉 📮 +-(14) 2 🖙 🛥 🛞 🔎 🦶 😂 🔣 Quit • Environment Import Convert Process Display Calibration ----. 1100Easter 1 -The way is a second sec - PolSARpro v5.0 - Run Trace-Open Window Warning Close Window Warning -

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🖉 Polarimetric SAR Data Processing and Educational Tool v5.0 - Menu					
T3 Environment Import Convert Process Display Calibration	Linear (+45 / -45) Circular (L / R) Elliptical (phi, tau) Box Car Filter Box Car - Edge Filter Gaussian Filter J.S. Lee Refined Filt J.S. Lee Sigma Filter P.W.F Filter Edge Detector		JRH : Huynen Decompo RMB1 : Barnes 1 Decom RMB2 : Barnes 2 Decom SRC : Cloude Decompo WAH1 : Holm 1 Decomp WAH2 : Holm 2 Decomp HAA : H / A / Alpha Dec FRE2 : Freeman 2 Com FRE3 : Freeman 3 Com VZ3 : Van Zyl 3 Compor YAM3 : Yamaguchi 3 Co YAM4 : Yamaguchi 4 Co NEU : Neumann 2 Comp	sition aposition aposition sition sosition composition ponents Decomposition ponents Decomposition apponents Decomposition	
Correlation Coefficients Elliptical Basis Change Polarimetric Speckle Filter H / A / Alpha Decomposition Polarimetric Decompositions Polarimetric Functionalities - 1 Polarimetric Functionalities - 2	Decomposition Para Eigenvector Set Par Eigenvalue Set Par	ameters rameters ameters	KRO : Krogager Decom CAM : Cameron Decom TSVM : Touzi Decompos	position position sition	
Polarimetric Segmentation Polarimetric Data Analysis Polarimetric Data Clustering Batch Process	H / A / Alpha Classification H / A / Alpha - Wishart Classification Fuzzy - H / Alpha Classification Wishart Supervised Classification Rule-Based Hierarchical Classification Basic Scattering Mechanism Identification	Faraday Rotation Estima Conformity Coefficient Scattering Predominance Scattering Diversity Degree of Purity Depolarisation Index	e	Polarisation Synthesis Polarimetric Signature Stokes Parameters Compact Polarimetric M O.P.C.E R.C.S Max	ode
Quad – PolSAR (Spp, C2) Quad – PolSAR (S2, C3,C4,T3,T4)	SVM Supervised Classification Data Statistics Data Histograms Data Profiles Histogram Based Statistics Texture Analysis	Alpha Approximation (Pr Entropy Approximation (Scattering Mechanisme I Scattering Mechanisme I Kozlov Anisotropy Lueneburg Anisotropy Polarized Point Scattere Reflectivity Ratio	raks & Colin) (Praks & Colin) Entropy (Freeman) Entropy (Van Zyl) r Detection	Surface Inversion RVOG PolSAR Inversion Sub-Aperture Analysis DEM Estimation Polarisation Orientation	Compensation
PuisAnpio volo - nuri mace Open Window Polarimetric Data Format Close Window Polarimetric Data Format	Clustering Process Parameter Averaging Data Sets Averaging	Differential Reflectivity ((ZDR)		Applications

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Version for the EO Scientific Investigator

PolSARpro v5.0 - Run Trace

Open Window Warning Close Window Warning

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Version for the EO Scientific Investigator

PolSARpro v5.0 - Run Trace

Open Window Warning Close Window Warning

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Histogram Based Statistics

Texture Analysis

PolSARpro v5.0 - Run Trace

Open Window Polarimetric Data Format Close Window Polarimetric Data Format



Version for the EO Scientific Investigator

PolSARpro v5.0 - Run Trace

Open Window Warning Close Window Warning

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Polarimetric SAR Data Processing and Educational Tool v5.0 - Menu





- 0 ×

PolSARpro – PoCal (Pocket Calculator)

- PolSARpro v5.0 - Run Trace

Open Window Polarimetric Data Format Close Window Polarimetric Data Format



culator v1.0	
Op #1 (Op#1) Operator (Op#2) Operand #1 File Mat S / M 2x2 mat 3x3 mat 4x4 mat	Operator : File C (file) + value C (file) - value C (file) * value C (file) / value C (file) .+ (file) C (file) (file) C (file) .* (file) C (file) ./ (file) C .real (.) C . imag (.) C . arg (.) C . abs (.) C .cos (.) C . sin (.) C . tan (.) C . conj (.) C .acos (.) C . asin (.) C . atan (.) C . boxcar (?x?) C .sqrt (.) C .(.)^2 C .(.)^3 C .(.)^7(?) C .log (1.1) C .ln (1.1) C .10^7(.) C .exp (.) C .10log (1.1) C .20log (1.1) C .(.)<(?)
Input File Input File Input File Input File Init Row End Row Init Col End Col OK Input Matrix Directory Input Matrix Data Format Init Row End Row Init Col End Col OK	Operator : Sinclair Matrix : S2 O [S] + value O [S] - value O [S] * value O [S] / value O [S] + (file) O [S] (file) O [S] .* (file) O [S] ./ (file) O [S] .+ (file) O [S] (file) O [S] .* (file) O [S] ./ (file) O [S] .+ (S'] O [S] .+ [mat] O [S] .* [S'] O [S] .* [mat] O [S] .* [S] * O [U] t.* [S] .* [U] O OK O . conj [S] O . tr [S] O . det [S] O . inv [S] O . eig1 [S] O . eig2 [S] O . eig1 [G] O . eig2 [G]
Input Value Type Input Value O Complex Value O Float Value N x N Matrix O Complex O C Complex O C Complex </td <td>Operator : Hermitian Matrix : C2, C3, C4, T2, T3, T4 C [M] + value C [M] - value C [M] / value C [M] + value C [M] - value C [M] / value C [M] + value C [M] - value C [M] / value C [M] + value C [M] - value C [M] / value C [M] + value C [M] - value C [M] / value C [M] + value C [M] - value C [M] / value C [M] + (file) C [M] - value C [M] / value C [M] + (file) C [M] - value C [M] / value C [M] + (file) C [M] - value C [M] / value C [M] + (file) C [M] - value C [M] / value C [M] + (file) C [M] - value C [M] / value C [M] + (file) C [M] - value C [M] / value O [M] + (file) C [M] - value C [M] / value O [M] + (file) C [M] - value C [M] / value O [M] + (file) C [M] / value C [M] / value O [M] + (file) C [M] / value C [M] / value O [M] + (M] C [M] / value C [M] / value O [M] + (M] C [M] / value C [M] / value O [M] + (M]</td>	Operator : Hermitian Matrix : C2, C3, C4, T2, T3, T4 C [M] + value C [M] - value C [M] / value C [M] + value C [M] - value C [M] / value C [M] + value C [M] - value C [M] / value C [M] + value C [M] - value C [M] / value C [M] + value C [M] - value C [M] / value C [M] + value C [M] - value C [M] / value C [M] + (file) C [M] - value C [M] / value C [M] + (file) C [M] - value C [M] / value C [M] + (file) C [M] - value C [M] / value C [M] + (file) C [M] - value C [M] / value C [M] + (file) C [M] - value C [M] / value C [M] + (file) C [M] - value C [M] / value O [M] + (file) C [M] - value C [M] / value O [M] + (file) C [M] - value C [M] / value O [M] + (file) C [M] / value C [M] / value O [M] + (file) C [M] / value C [M] / value O [M] + (M] C [M] / value C [M] / value O [M] + (M] C [M] / value C [M] / value O [M] + (M]
m11 +i m12 +i m13 +i m14 +i m21 +i m22 +i m23 +i m24 +i Load m31 +i m32 +i m33 +i m34 +i Save m41 +i m42 +i m43 +i m44 +i Save Output Value Exec Save Save Exit Exit	Operator : Complex / Hermitian / Float / Special Unitary NxN Matrix O [mat] + value O [mat] - value O [mat] * value O [mat] / value O [mat].+ [mat'] O [mat] [mat'] O [mat].* [mat'] O [mat]./ [mat'] O . det [mat] O . tr [mat] O . conj [mat] O . inv [mat] O . eig1 [mat] O . eig2 [mat] O . eig3 [mat] O . eig4 [mat]



External Softwares

G.I.M.P





GNU Image Manipulation Program Open Source GNU License (Win, Linux, Unix)



<u>a</u> [

IMAGE MAGICK

esa



IMAGE MAGICK





GOOGLE EARTH

esa





GOOGLE EARTH



Google"

Altitude 140.29 km

_ 8 ×

Data SIO, NOAA, U.S. Navy, NGA, GEBCO Image © 2010 TerraMetrics

lat 37.868979° long -122.007904° élév. 249 n

Date des images satellite : 2 oct. 2009

GOOGLE EARTH



_ 8 ×



S.R.T.M - ASTER





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S.R.T.M





S.R.T.M





ASTER





ASTER









GIS SOFTWARES



MAP READY





















MAP READY - NEST



MAP READY - NEST



MAP READY - NEST







NEST



MAP READY

ALOS – PALSAR





PolSARpro – SIM



PolSARpro v3.31 SOFTWARE

🖉 PolSARpro Simulator (c) Dr Mark L. Williams 📃 🗖 🗙
PolSARproSim
Output Master Directory
C:/DEV_PolSARpro_v3.0_track0
Output Slave Directory
C:/DEV_PolSARpro_v3.0_track1
Geometric Configuration
Platform Altitude (m) 3000. Horizontal Baseline (m) 10.0
Incidence Angle (deg) 45. Vertical Baseline (m) 1.0
System Configuration
Centre Frequency (GHz) 1.30 Azimuth Resolution (m) 1.5 Slant Range Resolution (m) 1.06066
Ground Surface Configuration
Surface Properties (Smoothest = 0 Roughest = 10)
Ground Moisture Content (Driest = 0 Wettest = 10)
Azimuth Ground Slope (%) 2.0 Range Ground Slope (%) 1.0
Forest Configuration
Tree Species Hedge (0) Pine (1,2,3) Deciduous (4)
Tree Height (m) 18.0 Forest Stand Density (stems / Ha) 300
Forest Stand Circular Area (Ha) 0.282745
Random Number Generator 35961 Save Config
Final Image Number of Rows 105 Final Image Number of Columns 141
Configuration File
C:/DEV_PolSARpro_v3.0_track0/pspsim_config
Run 🛛 🧟 Exit

- PolSARproSim is a rapid, coherent, fully polarimetric SAR simulation of forest for demonstrating POLinSAR techniques within PolSARpro Software v3.31.
- **PolSARproSim** generates simulated interferometric SAR images of artificial forest scenes that may be analysed as real SAR imagery.
- SAR properties and imaging geometry are obtained from the user who specifies centre frequency, azimuth and slant range resolutions, along with platform altitude, incidence angle and horizontal and vertical interferometric baselines.
- Ground surface generation is controlled by specifying the surface properties slope, roughness and wetness (on simple sliding scales) and local properties (species, height, stand density and stand area).

PolSARpro – SIM

The SAR image is evaluated as a coherent sum of scattering events from small elements of the scene



RANDOM HEDGE



```
DECIDUOUS
```



Direct-Ground, Direct-Volume and Ground-Volume contributions are included, with both trees and short vegetation comprising Volume terms.

esa





and dimensions a grid of points is used to sample the attenuation of the coherent wave in 3D

PolSARpro – SIM





View from Radar





Pauli RGB Image



Coherence Map using a 5x5 window - Magnitude (left) and Phase (right)

PolSARpro Simulators



🖉 PolSARpro Simulator (c) Dr Mark L. Williams	<u>- ×</u>
PolSARproSim	
Output Master Directory	
C:/DEV_PolSARpro_v3.0_track0	- L
Output Slave Directory	
C:/DEV_PolSARpro_v3.0_track1	- 1 🖻
Geometric Configuration	
Platform Altitude (m) 3000. Horizontal Baseline (m)	10.0
Incidence Angle (deg) 45. Vertical Baseline (m)	1.0
System Configuration	
Centre Frequency (GHz) 1.30 Azimuth Resolution (m) Slant Range Resolution (m)	1.5 1.06066
Ground Surface Configuration	
Surface Properties (Smoothest = 0 Roughest = 10)	0 • •
Ground Moisture Content (Driest = 0 Wettest = 10)	1 -
Azimuth Ground Slope (%) 2.0 Range Ground Slope (%)	1.0
Forest Configuration	
Tree Species Hedge (0) Pine (1, 2, 3) Deciduous (4)	4 ▲▼
Tree Height (m) 18.0 Forest Stand Density (stems / Ha)	300
Forest Stand Circular Area (Ha) 0.282745	
Random Number Generator 35961 Sa	ave Config
Final Image Number of Rows 105 Final Image Number of Colu	mns 141
Configuration File	
C:/DEV_PolSARpro_v3.0_track0/pspsim_config	
Run 🛛 🦉	Exit





PoISARproSIM_Veg

PolSARproSIM_Grd



Polarimetric SAR Data Process	sing and Educational Tool v5.0 - Menu Convert Process Display Calibration	ASS Rest		<u>ا۔</u> یہ کمان کے ایک کی ک
SABoro v5.0 - Run Trace	Image:	Image Number of Columns Image Number of Columns	Image: Second State Configuration Configuration Plate Configuration Particle Configuration Plate Configuration Plate Configuration Plate Configuration Plate Configuration System Configuration Centre Frequency (GHz) 1.30 Surface Properties (Smoothest = 0) Wettest = Azimuth Bround Slope (%) Configuration Tree Species Hedge (0) Forest Configuration Tree Height (m) 18.0 Forest Stand Density (ster Forest Stand Circular Area (Ha) 0.282745 Frail Image Number of Bows Final Image Number of Bows	Image: Second


PolSARpro v5.0 SOFTWARE Cesa



Learning / Training Next P.I Generations

PolSARpro v5.0 SOFTWARE





PolSARpro Cesa

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Educational Tools

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🖉 Polarin	netric SAR Data Processing and Educational Tool v5.0 - Menu	
▼ T3	Environment Import Convert Process Display Calibration	nest 📀 🔽 🛛 🗣 🛥 🎅 🧏 📐 😒 🔨 Quit . About 🖌 📮
	Adder Actobert Streederd - (Lossic L'inneepts act) X Extrine gation diffictings (Dourrent Commentaires Quite Optice soundes Fegère 1X Extrine gation diffictings (Dourrent Commentaires Quite Optice soundes Fegère 1X Commentaires (Quite Soundes Fegère 2X Commentaires (Quite Soundes Fegère 2X Commentaires (Quite Soundes Fegère 2	
	POLSARPRO V3.0 - LECTURE NOTES BASIC CONCEPTS IN RADAR POLARIMETRY	
	Wolfgang-Martin BOERNER UIC-ECE Communications, Sensing & Navigation Laboratory 500 W. Taylor St., SEL (607) W-210, MC 154, CHICAGO IL/USA-60607-7018 Email Insemer@scentic.adu	Direct access to the Tutorial while using PoISARpro facilities
	1 Introduction: A Review of Polanmetry 4 2 The Electromagnetic Vector Wave and Polanzation Deverations 6 2.1 Polanzation Vector and Complex Polanzation Ratio 6 2.2 The Polanzation Ellipse and its Parameters 7 2.3 The Journa Vector and Changes of Polanzation Brass 0 2.4 Complex Polarization Ratio in Deffectut Polarization Brass 12 2.4.1 Complex Polarization Ratio in the Linear Brais (H V) 13 2.4.2 Complex Polarization Ratio in the Linear Brais (H V) 13 2.4.3 Complex Polarization Ratio in the Linear Brais (H V) 13 2.4.3 Complex Polarization Ratio in the Linear Brais (H V) 13 2.4.3 Complex Polarization Ratio in the Linear Brais (12 P) 13 2.5 The Stokes Parameters 15	The Tutorial is made available in PDF format.
	2.3.1 The Stokes vector for the completely polarized wave 10 2.5.2 The Stokes vector for the polarized wave 16 2.6 The Poincaré Polarization Sphere 18 2.6.1 The polarization of the Poincaré sphere for the (H V) bears 19 2.6.3 The polarization ratio on the Poincaré sphere for different polarization bases 20 2.6.3 The relationship between the Stokes vector and the polarization ratio for different polarization sphere and complex polarization ratio plane 22 2.6.4 The Poincaré polarization sphere and complex polarization ratio plane 24 2.7 Ware Decomposition Theorems 23	 Recent Advances in Radar Polarimetry and Polarimetric SAR Interferometry W.M. Boerner – 31 pages Basic Concepts in Radar Polarimetry W.M. Boerner – 100 pages
	2.8 The Work Decision of the Polarization Properties of Electromagnetic Vector Waves 26 2.9 Polarization of the Polarization Properties of Electromagnetic Vector Waves 26 3 The Electromagnetic Vector Scattering Operator and the Polarimetric Scattering Matrices 3.1 The Scattering Scenario and the Scattering Coordinate Francework 3.2 The National Portunation of the Scattering Coordinate Francework 3.3 The National Portunation of the National Scattering Matrices 3.3 The National Portunation of the National Scattering Matrices 3.4 The Auto Interformations of the National Scattering Matrices 3.4 The 4x4 Moeller (Forward Scattering) [M] and the 4x4 Kennangh (Back-Scattering) [K] Person Density Matrices 33 3.5 The Original Research Scattering Matrices	 Advanced Concepts E. Pottier, J.S. Lee, L. Ferro-Famil – 65 pages POL-InSAR Training Course S.R. Cloude – 44 pages
	3.6 CurCanas-Polis Backacathering Polise Decomposition for the One-Antenna (Transcriver) and the Marched Two America (Quasi Monovaric) Cases 34 3.7 The Scattering Feedback Vectors: The Lexicographic and the Pauli Feedback Vectors 36 3.8 The Universy Transformations of the Destruct Vectors 36 3.8 The Universy Transformations of the Destruct Vectors 37 3.9 The Polarize Transformations of the Destruct Vectors 37 3.9 The Polarize Transformations of the Destruct Vectors 38 3.10 The Monovatic Receptoral Back-Scattering Cases 39 3.11 Co Cross-polar Power Descript and Phase Correlation Representations 41 3.12 Alternate Matrix Representations 43	• PCT Training Course S.R. Cloude – 55 pages
- PolSARpr Open Wind Close Wind		

Educational Tools

/ PolSAR-ap Showcase : Agriculture	×
Input Directory	
D:/My_Data_Directory/T3	
Output Directory	
D:/My_Data_Directory / T3	
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Decomposition	320
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Surface Soil Moisture Inversion	
Soil Dielectric Constant Max 40	
Increment Angle of the Incidence Angle LUT (deg)	
Dihedral Soil Moisture Inversion	
Soil Dielectric Constant Max Trunk Dielectric Constant Max	
Increment Angle of the Incidence Angle LUT (deg)	
2D-Incidence Angle File	
Enter 2D Incidence Angle File	2
2D Mask File	
Enter (showcase_agri_mask.bin) file	ē
Polarimetric Decomposition fs File	
Enter (showcase_agri_fs.bin) file	-
Polarimetric Decomposition Beta File	
Enter (showcase_agri_beta.bin) file	-
· - Vertical Rougness Indicator (ks) File (optional)	
Uutout Soil Moisture File	
D://Nu Data Directoru/showcase agri surf my soil bin	
Output Soil Dielectric Constant File	
D:/My_Data_Directory/showcase_agri_surf_dc_soil.bin	
Output Trunk Dielectric Constant File	
Hun Exit	

Input Directory D:/My_Data_Directory/T3 Output Directory D:/My_Data_Directory Init Row I End Row I544 Init Col I End Col 928 Window Size - Train Window Size - Test Row Col 9
D:/My_Data_Directory/T3 Output Directory D:/My_Data_Directory Init Row 1 End Row 1544 Init Row 1 End Row 1544 Init Row 1 End Row 1544 Init Row 1 End Row 1 Col 1 Bow 1 Col 1 Bow 1 Col 1 Bow 1 Col 1 Bow 1 Col 1 <
Output Directory / T3 D:/My_Data_Directory / T3 Init Row 1 End Row 1544 Init Col 1 End Col 928 Window Size - Train Window Size - Test Window Size - Test Row 9 Col 9 Geometric Perturbation Filter Threshold 0.98 Reduction Ratio (RedR) 0.0025 Output Coherence File D:/My_Data_Directory/ocean_coherence.bin 0 0 0 D:/My_Data_Directory/ocean_mask.bin D:/My_Data_Directory/ocean_mask.bin 0 0 0
D:/My_Data_Directory / T3 Init Row 1 End Row 1544 Init Col 1 End Col 928 Window Size - Train Window Size - Test Window Size - Test Row 9 Col 9 Geometric Perturbation Filter Threshold 0.98 Reduction Ratio (RedR) 0.0025 Output Coherence File D:/My_Data_Directory/ocean_coherence.bin Output Mask File D:/My_Data_Directory/ocean_mask.bin Directory/ocean_mask.bin Directory/ocean_mask.bin
Init Row 1 End Row 1544 Init Col 1 End Col 928 Window Size - Train Window Size - Test Row 9 Col 9 Row 51 Col 51 Row 9 Col 9 Geometric Perturbation Filter Threshold 0.98 Reduction Ratio (RedR) 0.0025 Output Coherence File D:/My_Data_Directory/ocean_coherence.bin 0 0 0 D:/My_Data_Directory/ocean_mask.bin 0 0 0 0
Window Size - Train Row 51 Col 51 Geometric Perturbation Filter Threshold 0.98 Reduction Ratio (RedR) 0.0025 Output Coherence File D:/My_Data_Directory/ocean_coherence.bin Output Mask File D:/My_Data_Directory/ocean_mask.bin
Row 51 Col 51 Geometric Perturbation Filter Threshold 0.98 Dutput Coherence File D:/My_Data_Directory/ocean_coherence.bin Dutput Mask File D:/My_Data_Directory/ocean_mask.bin
Geometric Perturbation Filter Threshold 0.98 Reduction Ratio (RedR) 0.0025 Output Coherence File D:/My_Data_Directory/ocean_coherence.bin Output Mask File D:/My_Data_Directory/ocean_mask.bin
Threshold 0.98 Reduction Ratio (RedR) 0.0025 Output Coherence File D:/My_Data_Directory/ocean_coherence.bin Output Mask File D:/My_Data_Directory/ocean_mask.bin
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Output Mask File D:/My_Data_Directory/ocean_mask.bin
D:/My_Data_Directory/ocean_mask.bin
Run 🖸 Exit

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Educational Tools

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🖊 PolSAR-ap Showcase : Cryosphere	×		
Input Master - Slave Directory			
D:/My_Data_Directory/Master_Dir_Slave_Dir			
Output Master - Slave Directory			
D:/My_Data_Directory/Master_Dir_Slave_Dir			
Init Row 1 End Row 900 Init Col 1 End Col	1024	🖡 PolSAR-ap Showcase : Urban	×
Decomposition Inc Ang Unit Median Filter	_	- Input Master - Slave Directory	
Window Size (Row) O Degrees Window Size Window Size (Col) Image: Radians Max Nb of Iterations	8 3	D:/My_Data_Directory/Master_Slave_Dir/T6	-
		- Output Master - Slave Directory	
Polarization Channel Ice Dielectric Constant 2.8 Threshold	40	D:/My_Data_Directory/Master_Slave_Dir	6
Range Pixel Spacing (optional) opt		Init Row 1 End Row 900 Init Col 1 End Col	1024
- 2D Incidence Angle File		Complex Coherence File	
Enter 2D Incidence Angle file	- 2		- 🖻
- 2D Kz File		Output File	
Enter 2D Kz file	2		
Surface to Volume Ratio File			
Enter (showcase_cryo_stv_ratio_HH.bin) file	- 2	Bun Exit	
- Complex Coherence File			
Enter (cmplx_coh_HH.bin) file	- 🗃		
- SNR Decorrelation File (optional)			
Enter SNR Decorrelation file (Optional)	- 🛩		
Output Extinction Coefficient File (kappa)			
D:/My_Data_Directory/Master_Dir_Slave_Dir/showcase_cryo_kappa_HH.bin			
Output Penetration Depth File			
D:/My_Data_Directory/Master_Dir_Slave_Dir/showcase_cryo_depth_HH.bin			
Run 🖸 Exit			
fatter	-		

PolSARpro v5.0 SOFTWARE

http://earth.esa.int/web/polsarpro The Web Site provides

ata Sources 🔹 Overview 👻 Download and Installation - Documentation -	Results & News -		
w are here Home	🛨 Share 📫 💟 🚥 👳		
- PolSARpro Version 4.2	- Latest News		
The Polarimetric SAR Data Processing and Educational Tool aims to facilitate the accessibility and exploitation of multi-polarised SAR datasets including those from ESA Third Party Missions (ALOS PALSAR), Envisat ASAR Viternating Polarisation mode products, RADARSAT-2 and TerraSAR-X. A wide-range of tubrials and comprehensive documentation provide a grounding in polarimetry and polarimetric interferometry necessary to stimulate research and development of scientific applications that utilise such lechniques; the toolbox of processing functions offers users the capability to implement them.	New PolSARpro version 4.2 released New PolSARpro version 4.1.5 released New PolSARpro version 4.0 Beta 1.3 released PolSARpro v.4.0 beta 1 training course - PolSARpro version 4.0 beta 1 released for		
PoISARpro is developed under contract with ESA, a consortium <u>IETR (<i>Institut d'êlectronique et de</i></u> <u>lélécommunications de Rennes</u>) in conjunction with the <u>University of Rennes 1, DLR Microwaves and Radar</u> <u>institute (HR) of DLR</u> and AEL Consultants, together with Dr Mark Williams. The initiative is a direct result of recommendations made at the <u>POLInSAR Workshops</u> held at ESRIN since January 2003.	Useful Links Home Data Sources		
All elements of the PoISARpro project are distributed by ESA free of charge, including the source code. This website provides details of the project, giving users access to the tutorial material and software, information about sources of multi-potarised data and recently obtained results of POLInBAR studies. Navigate between pages using the menu on the left.	Overview Download PolSARpro 4.2 Release Notes Polarimetry Tutorial Technical Decumentation		
	Results & News Contact		

Details of the project

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- Access to the tutorial and software
- Information about status of the development

Demonstration Sample Datasets

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> 3rd ADVANCED COURSE ON RADAR POLARIMETRY POISARpro v5.0

Practical – Part 1



Eric POTTIER



19–23 January 2015 | ESA-ESRIN | Frascati (Rome), Italy

European Space Agency



General Presentation of PolSARpro v5.0 Software

Compatible Raw Binary Data

🔍 C:\DATADIR					
<u>Fichier</u> <u>E</u> dition Affic <u>h</u> age	Fa <u>v</u> oris <u>O</u> utils	2			<u>1</u>
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🚊 🔄 DATADIR	<u> </u>	C4	🔊 s22.b	in	
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		T4			
ТЗ		s11.bin			
T4	- I 🖻	s12.bin			
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2x2 Complex Sinclair Matrix [S2]



Nrow

1234

Ncol 4789

PolarCase

PolarType

Monostatic/Bistatic/Intensities

Full/pp1/pp2/pp3/pp4/pp5/pp6/pp7

PolarCase

- Monostatic
- Bistatic
- Intensities

s12.bin == s21.bin s12.bin <> s21.bin lxy.bin

PolarType

- Full s11.bin, s12.bin, s21.bin, s22.bin
- pp1 s11.bin, s21.bin
- pp2 s12.bin, s22.bin
- pp3 s11.bin, s22.bin
- pp4 l11.bin, l12.bin, l22.bin
- pp5 l11.bin, l21.bin
- pp6 l12.bin, l22.bin
- pp7 l11.bin, l22.bin

Compatible Raw Binary Data



$$\underline{k}_{3P} = \frac{1}{\sqrt{2}} \begin{bmatrix} S_{11} + S_{22} & S_{11} - S_{22} & S_{12} + S_{21} \end{bmatrix}$$

 $[T_3]$

 \implies



$$\implies [T_3] = \langle \underline{k}_{3P} \cdot \underline{k}_{3P}^{\dagger} \rangle$$
$$[T_3] = \begin{bmatrix} T_{11} & T_{12} & T_{13} \\ T_{12}^* & T_{22} & T_{23} \\ T_{13}^* & T_{23}^* & T_{33} \end{bmatrix}$$



Compatible Raw Binary Data



$$\underline{k}_{3L} = \begin{bmatrix} S_{11} & S_{12} \cdot \sqrt{2} & S_{22} \end{bmatrix}$$

4.10

- + .

$$\implies [C_3] = \langle \underline{k}_{3L} . \underline{k}_{3L} \rangle$$
$$[C_3] = \begin{bmatrix} C_{11} & C_{12} & C_{13} \\ C_{12}^* & C_{22} & C_{23} \\ C_{13}^* & C_{23}^* & C_{33} \end{bmatrix}$$

F ~ 3



C33.bin

Compatible Raw Binary Data



$$\implies [T_4] = \langle \underline{k}_{4P} . \underline{k}_{4P}^{\dagger} \rangle$$

$$[T_4] = \begin{bmatrix} T_{11} & T_{12} & T_{13} & T_{14} \\ T_{12}^* & T_{22} & T_{23} & T_{24} \\ T_{13}^* & T_{23}^* & T_{33} & T_{34} \\ T_{14}^* & T_{24}^* & T_{34}^* & T_{44} \end{bmatrix}$$



Compatible Raw Binary Data



$$\underline{k}_{4L} = \begin{bmatrix} S_{11} & S_{12} & S_{21} & S_{22} \end{bmatrix}$$

$$\implies [C_4] = \langle \underline{k}_{4L} \cdot \underline{k}_{4L}^{\dagger} \rangle$$
$$[C_4] = \begin{bmatrix} C_{11} & C_{12} & C_{13} & C_{14} \\ C_{12}^* & C_{22} & C_{23} & C_{24} \\ C_{13}^* & C_{23}^* & C_{33} & C_{34} \\ C_{14}^* & C_{24}^* & C_{34}^* & C_{44} \end{bmatrix}$$





CONFIGURATION











→ SENTINEL TOOLBOX
SNAP | Sentinels Application Platform

PolSARpro v5.0 SOFTWARE







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ALOS : Advanced Land Observing Satellite PALSAR : Phase Array L-Band SAR



PolSARpro v5.0 SOFTWARE



Polarimetric SAR Data Processing and Educational Tool v5.0 - Menu



lat 38.095148° long -121.876969°

→ 3rd ADVANCED COURSE ON RADAR POLARIMETRY 19-23 January 2015 | ESA-ESRIN | Frascati (Rome), Italy 139.76 km



19-23 January 2015 | ESA-ESRIN | Frascati (Rome), Italy

PROCESSING CHAIN







PROCESSING CHAIN



PROCESSING CHAIN





Display



PolSARpro v5.0 - Run Trace

Open Window Warning Close Window Warning

an 👔





PROCESSING CHAIN







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	Martin Martin and and and a second
Polarimetric SAR Data Processing and Educational Tool v5.0 - Menu	
Environment Import Convert Process Display Calibration	
🖊 ALOS Input Data File (JAXA - CEOS Format)	
C:/DataDirectory	(ADVILE
Output Directory	PolSARpro WILL TAKE INTO ACCOUNT THE
C:/DataDirectory	
SAR Leader File (LED-xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx	WITH : s12 = VH and s21 = HV
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Data IMPORT – Extract Binary Data



Data IMPORT – Extract Binary Data





Display Pauli-RGB Image



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PolSARpro v5.0 SOFTWARE

MapReady - Geocode Matrix Input Directory Dr/SAN_FRANCISCO_ALOS/T3 Output Directory Dr/SAN_FRANCISCO_ALOS/LOS_MapReady / T3 SAR Leader Ele. (I ED- SAN_FRANCISCO_ALOS/LED-ALPSRP202350750-P1.1_A SAN_FRANCISCO_ALOS/LED-ALPSRP202350750-P1.1_A SAN_FRANCISCO_ALOS/LED-ALPSRP202350750-P1.1_A SAN_FRANCISCO_ALOS/LED-ALPSRP202350750-P1.1_A SAN_FRANCISCO_ALOS/LED-ALPSRP202350750-P1.1_A	ric SAR Data Processing and Educational Tool v5.0 - Menu ivironment Import Convert Process Display Calibration 📰 <equation-block> 🗐 🕼 🗐</equation-block>	
	MapReady - Geocode Matrix Input Directory D:/SAN_FRANCISCO_ALOS/T3 Output Directory D:/SAN_FRANCISCO_ALOS_MapReady /T3 SAR Leader File (LED D:/SAN_FRANCISCO_ALOS/LED-ALPSRP202350750-P1.1_A C Resampling Method Bicubic Bicubic Output Parameters Geocoding : UTM Default Parameters Geocoding : UTM Datum : WGS84 Zone : < from metadata > Input Format : PolSARpro OK	MapReady - Terrain Correction Input DEM File D:/SAN_FRANCISCO_ALOS/SRTM/srtm_12_05.tif Fill DEM holes with interpolated values Refine Geolocation Only Apply Terrain Correction Apply a User Mask A Automatically Mask Mask from File Input Mask File Skip Co-Registration (if it fails) Apply Radiometric Terrain Correction Apply Radiometric Terrain Correction

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Display Pauli-RGB Image

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Create Pauli-RGB to KML Image



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ENVIRONNEMENT

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Practical – Part 2



Eric POTTIER



19–23 January 2015 | ESA-ESRIN | Frascati (Rome), Italy

European Space Agency

PolSARpro v5.0 SOFTWARE





ALOS : Advanced Land Observing Satellite PALSAR : Phase Array L-Band SAR





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Convert Data

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🥖 Data Processing: H / A / Alpha Eigenvalue Set Parameters	×
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Pseudo Probabilities (p1 , p2 , p3)	🔽 ВМР
Anisotropy (A) (p2, p3)	🗖 ВМР
Anisotropy12 (A12) (p1, p2)	🗖 ВМР
Eigenvalues Relative Difference (S.E.R.D - D.E.R.D)	🖵 ВМР
Polarisation Asymmetry (p1-p3, 1-3p3)	🔽 BMP
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Polarimetric SAR Data Processing and Educational Tool v5.0 - Menu	
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Pauli Yamaguchi Y40





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Pauli Yamaguchi S4R





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Pauli Yamaguchi G4U2





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POLARIZATION SYNTHESIS



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Coded Colormap Pauli Sinclair Sinclair S11+S22 S12+S21 S11-S22 S22
Run 📿 Exit

Do it Yourself: Set the parameters, run and view the corresponding BMP files.

PolSARpro v5.0 - Run Trace

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WISHART - H/A/alpha CLASSIFICATION



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	Data Processing: Wishart Supervised Classification
	C:/DataDirectory_MapReady/T3
	Output Directory
	C:/DataDirectory_MapReady / T3 🔁
	Init Row 1 End Row 1544 Init Col 1 End Col 932
	FULL-POLSAR SUPERVISED CLASSIFIER
	Classification Configuration
	🔽 BMP 🔽 Reject Class 🔽 Confusion Matrix
	Window Size 1 Reject Ratio CM Editor CMR Editor
	Color Maps
1	ColorMap 16 C:/Documents and Settings/Eric POTTIER/Application Data/PolSARpro_ 😂 Edit
	□ Pauli (\$11,\$22) (\$12,\$21) (\$11,\$22)
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	Liraphic Editor Lext Editor Run Training Process
1	Set File C:/DataDirectory_MapReady/T3/training_cluster_centers.bin
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- **1:** Select the Output Directory
- 2 : Select the Output Image Number of Rows and Columns

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- 3 : Select BMP creation files, Reject Class and Confusion Matrix. Note: BMP and Confusion Matrix are selected by default
- 4 : Enter the Window Size (Nwin = ?) and the Reject Ratio Coefficient (if Reject Class option is selected)
- **5** : Edit the ColorMap and choose the colours associated to the different classes
- 6 : Select (or not) the Coded ColorMap option
- 7 : Enter the name of the Training Areas list text file The default output file name is set to: Config / training_areas.txt
- 8 : Open Graphic Editor to define graphically the Areas of Interest (AoI) or run Text Editor to enter the coordinates of the Areas of Interest (AoI)in the Training Areas text file
- 9 : Run Training Process. This program will define the training clusters centres from the selected Areas of Interest (AoI).
- **10** : Run the Wishart Supervised Classification procedure

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About



- 1 : Create a new Training Class and add it to the list.
- 2 : Delete the current Training Class from the list.
- **3** : Create a new Training Area and add it to the list of the current Training Class.
- 4 : Delete the current Training Area from the list.
- **5** : Clear the different contours on the chosen image.
- 6 : Delete all the Training Classes and associated Training Areas from the list.
- 7 : Save the Training Class and associated Training Areas list. The default output file name is set to MD / training_areas.txt.
- 8 : Rectangular selection of Area of Interest (AoI).
- 9 : Polygonal selection of Area of Interest (AoI).

Note: The contour is automatically closed by clicking on the Mouse Right Button.

- **10** : Toggle selected area contour color (black / white).
- Class 🏟: Redraw all the Training Areas of the current Training Class.
- Class **Av**: Move in the up/down direction in the Training Class list.
- Area 🏟: Redraw the current Training Area of the current Training Class.

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Open Window Warning Close Window Warning • Area **Area** Move in the up/down direction in the Training Area list of the current Training Class.





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Polarimetric SAR Data Processing and Educational Tool v5.0 - Menu	
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☐ Sinclair S11 (S12+S21)/2 S22	C1 31012 C2 4539
Training Areas	C3 1764 C4 3662
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SUPPORT VECTOR MACHINE CLASSIFICATION - 0 × Polarimetric SAR Data Processing and Educational Tool v5.0 - Menu C esa SNAP About 🞻 💷 ۰ſ Quit Environment Import Convert Process Display Calibration ee 19 📈 📈 電 2 - 22 Data Processing: SVM Supervised Classification -Input Directory D:/SAN_FRANCISCO_ALOS_MapReady/T3 Output Directory / 13 🗀 D:/SAN_FRANCISCO_ALOS_MapReady X SVM RBF Kernel Parameters Optimisation (Cross Validation) (Ne répond pas) 1544 1 End Row End Col 928 Init Row Init Col Log2(C) £ Log2(G) ISO Accuracy G Step 1 - Training Areas 91.5% 8 256.0 -5 0.03125 93.0% Min Min Graphic Editor 92.5% Areas File D:/SAN_FRANCISCO_ALOS_MapReady/T3/sym_training_areas.txt 2 92.8% Text Editor 91.5% Max 🎒 14 16384.0 0 1.0 Max. 91.0% Step 2 - Classification Configuration Log₂(7) BMP CM Editor Step 2 Step 1 Confusion Matrix Step 3 - Color Maps One best couple (C,G) ColorMap 16 C:/Users/epottier/AppData/Roaming/PolSARpro 5.0.0/ColorMap/Supervised ColorMap16.pal 😅 Edit **Run RBF Kernel Parameters Optimisation** G C 🔽 Pauli IS11+S22I IS12+S21I IS11-S22I Coded Colormap Sinclair [S11] [(S12+S21)/2] [S22] Exit and Save CV Parameters Step 4 - SVM Parameter Setting Input Polarimetric Indicators – - Sampling option Output SVM parameters T3 Class Probability E RM ✓ Training sampling 500 Mean Hyperplane Distance O Other Select If important unbalanced training point Useful but time ce -Step 5 - Kernel Parameter BBE BBE RECOMMANDED Crolynomial C Linear Optimisation parameters Cost 16384 Gamma = 1/sigma 0.5 Degree Setup and Run Step 6 - Run Classification Exit PolSARpro v5.0 - Run Trace Open Window Warning Close Window Warning AN 🚺 → 3rd ADVANCED COURSE ON RADAR POLARIMETRY

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